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TABLE III.—*Spleen examination of Mitchell County boys by age groups.*

Age (years).	Number examined.	Enlarged spleens found.			Age (years).	Number examined. ber.	Enlarged spleens found.		
		Number.	White boys.	Colored boys.			Num-	White boys.	Colored boys.
4	2	0	0	0	15	64	0	0	0
5	11	1	1	0	16	42	0	0	0
6	128	2	0	2	17	22	0	0	0
7	108	4	1	3	18	9	0	0	0
8	130	6	5	1	19	3	0	0	0
9	147	3	1	2	20	1	0	0	0
10	136	2	1	1	21	2	0	0	0
11	139	0	0	0					
12	121	1	1	0	Total, all ages	1,261	27	17	10
13	109	6	5	1					
14	87	2	2	0					

MODERN STEAM LAUNDRY PROCESSES AS A MEANS OF DESTROYING VERMIN.

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With the establishment of modern steam laundries at cantonments in this country, and of mobile units for overseas service, the question arose as to their usefulness in destroying body lice in clothing. The laundries branch, salvage division, of the quartermasters' corps, in cooperation with the Bureau of Entomology of the United States Department of Agriculture, took up the study of this question, and the work was done by the authors of this article.[1]

The principal problem was to determine whether woolens could be so treated in modern steam laundries as to insure complete destruction of body lice and yet produce no shrinkage or injury to the wool. The body or clothing louse, *Pediculus humanus*, var. *corporis*, was the only species dealt with. The insects used in the experiments were, for the most part, reared material of known age and condition. Both adults and the nits or eggs were obtained from lice reared in wristlets. The wristlet used was a slight modification of Nuttall's wristlet. It consisted of a pill box in which holes had been punched in both top and bottom. Over these openings was pasted a fine grade of chiffon. The boxes were held in place on the arm by elastic bands. Each box contained from 20 to 50 lice, with a bit of flannel cloth to which they could cling and to which they attached their eggs. Every second day the lice were transferred to a clean piece of cloth and returned to the wristlet. The piece of cloth, with attached eggs laid during the preceding 48 hours, was put into a new pill box of the same type. The eggs were counted, the boxes were numbered, and exact records were kept of each lot. These boxes were kept in an electrically heated incubator, at a temperature of about 30° C. and at rather high humidity. When these eggs were subjected to tests they were removed from the boxes and put into the pockets of woolen shirts, or sewed along the seams or under the armhole of a coat, in order to simulate natural infestation and to make the killing requirements as severe as possible. After the tests they were returned to the pill boxes and the incubator and kept under daily observation until all hatching had ceased. Check lots of eggs were kept under the same incubator conditions in all cases.

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[1] The final report was published in full in the National Laundry Journal of Chicago, Jan. 1, 1919, vol. 81, No. 1.

Material for test on the adult stages was obtained partly from naturally infested garments and partly from material which had been reared in pill boxes by feeding twice daily.

The cleansing processes as used in Army steam laundries may be divided into four main divisions, (1) washing, (2) extracting, (3) drying, and (4) finishing. Inasmuch as it sometimes happened that only a part of the necessary machinery was available, an endeavor was made to find a general washing formula in which each separate step would be effective, thus rendering it certain that the desired results would be obtained even if a drying tumbler were not available or if flat-work ironers or steam presses were not used.

Washing Processes.

Woolens generally have been washed in luke warm water at "hand heat." Experiments proved that this temperature was too low to be effective in the destruction of lice. Further studies were therefore made to determine the effects of higher temperatures in the washer upon vermin and also upon the fabrics, and a study was made of the relation of the higher temperatures, of soap, and of motion, to shrinkage. The series of experiments included tests with wash-water at temperatures of 75°, 115°, 125°, and 131° F. Tests with temperatures of 75° and 115° were found to be ineffective. Two experiments were conducted with water heated to 125° F.

In each case an O. D. wool shirt, containing eggs in the pockets, was washed with a normal load as follows:

Fifteen minutes, heavy suds, 125° F.

Three 3-minute rinses, 125° F.

Following extraction, the specimens were removed and kept for observation. In the first experiment the test lots of eggs failed to hatch; but the results were considered inconclusive because little or no hatching was obtained from the check lots of untreated eggs. In the second experiment, test lots of eggs gave from 20.9 to 65.2 per cent hatching, as compared with a hatching record of from 54.7 to 91.1 per cent in the check lots. Washing alone at 125° F. for this length of time is thus shown to be unreliable.

In experiments conducted with water heated to 131° F., entirely satisfactory results were obtained in every case.

In one of these experiments, conducted at a commercial laundry, two O. D. wool shirts were placed in the washer with a load of 11 blankets. One of the garments contained two lots of eggs, four to eight days old, a total of 460 eggs. The second garment contained a total of 338 eggs, a few hours to two days old. These were subjected to the following treatment:

Washed 15 minutes in light suds; the temperature of the water at the beginning was 132° F.; at the end, 126° F.

Rinsed in three 3-minute rinses; the temperature of the water at the beginning was 133° F.; at the end, 128° F.

After extraction for 20 minutes the eggs were removed and returned to pill boxes and kept in the incubator as usual. The destruction of the eggs in all these lots was complete; whereas untreated checks gave over 60 per cent of hatching.

The effect of this temperature on the shrinkage of woolens was found to be negligible when a light load of clothing was used. This point is brought out by the following experiments:

An army wool undershirt was subjected to the following washing formula, with a heavy load of clothing:

15 minutes, light suds, lukewarm water.
3 minutes, rinse, lukewarm water.
3 minutes, rinse, lukewarm water.
3 minutes, rinse, lukewarm water.
3 minutes, rinse, lukewarm water.

Measurements of the neck, across chest, across back, and length of back were made before the wash and after. The average shrinkage was 5.97 per cent.

In another test a wool undershirt was subjected to the following wash formula, with a very light load of clothing:

15 minutes, heavy suds, 131° F.
3 minutes, rinse, 131° F.
3 minutes, rinse, 131° F.
3 minutes, rinse, 131° F.

The measurements indicated an average stretch of 6.06 per cent.

These tests point to the fact that shrinkage is not caused so much by high temperature of water as by pounding, caused by overload of wheel. Therefore the temperature of 131° F. is permissible for washing woolens.

The use of soap is also found to have a very important bearing on the amount of shrinkage. Soap suds act as a cushion and decrease the pounding of the clothes, which reduces shrinkage. Actual tests in a wash wheel prove this fact. Clothes were washed with low suds and with heavy suds, and measurements of an undershirt were made in each case with the following results:

Low suds, average shrinkage, 2.55 per cent.

Heavy suds, average shrinkage, 0.80 per cent.

The laundry wash wheel may be used for other purposes than merely that of washing. Thus, when clothing is suspected of being infected with resistant spore-bearing bacteria, it is possible to use the wash wheel for the submersion of the clothing at even higher temperatures. Tests were conducted with water at 165° F. in the wash wheel. A woolen shirt containing louse-infected cloth in the pockets was placed in the water at this temperature, and the doors were closed. The wheel was not revolved, except that every 5 minutes a few revolutions were given. At the end of 20 minutes the shirt was removed. The eggs were kept under observation for many days, but failed to show any signs of development. The effect on the shrinkage of woolens, of soaking at this temperature, was also found to be negligible; and this is explained by the fact that the wheel was not revolved, with the result that there was no pounding of the clothes.

All wash wheels are equipped with steam pipes, and it is possible to use them for live steam sterilization on the same principle as that of the Serbian barrel and according to the methods carried out by Hunter and others in the Balkans and Egypt. It has been claimed by all writers that live flowing steam is less injurious to woolens than is steam under pressure or in a closed cylinder.

Several experiments were carried out with the laundry wash wheel. A shirt with infested cloth in the pockets was placed in the center of a mass of clothing in the wheel. The doors were then closed and a current of steam was turned on, the wash wheel remaining stationary. The water of condensation was let out at about 5-minute intervals, but otherwise the outlet was closed so that steam escaped only through the cracks and joints of the wheel. In all cases where the steam was allowed to flow through for a period of 15 minutes, the destruction of the eggs was complete. Exposure to current steam for 10 minutes was found effective in one case, but not in another. The results indicated that 15-minute exposure to current steam is the minimum which may be counted upon to produce satisfactory results; but even in this case, precaution must be taken to prevent overloading of the wheel and the consequent difficulty in securing thorough penetration of the steam. The shrinkage effect of live-steam treatment also proved to be negligible.

Two Government-issue winter undershirts, a pair of wool breeches, a wool blouse, and a wool blanket were measured and subjected to the following treatment:

The garments were placed in a washer, 36 by 36 inches, together with nine wool blankets. A current of steam was passed into the wheel for 15 minutes. Measurements were taken, and then the clothing was returned to the wheel for washing, as follows:

15 minutes, suds, water at 125° F.
3 minutes, rinse, water at 125° F.
3 minutes, rinse, water at 125° F.

Extracted 10 minutes. Tumbled for 15 minutes. Temperature at exhaust, 130° F. to 150° F. Pressed on a steam press.

	Effect of steam treatment.	Effect of pressing.
Undershirt	0.18 per cent stretch	0.55 per cent stretch
Undershirt	0.08 per cent stretch	2.35 per cent stretch
Wool breeches	0.0 per cent stretch	0.7 per cent stretch
Wool coat	0.0 per cent stretch	1.11 per cent stretch

The live steam treatment did not shrink the clothing. After the steam treatment the undershirts and coat were moist, but the breeches were dry.

The coat and breeches were not pressed properly, and so the final measurements are not absolutely correct, but they give an indication of the results of the test.

In another test, wool blankets were subjected to steam treatment in a wash wheel for 15 minutes, without revolving the wheel. The average shrinkage of two blankets was 0.14 per cent. In still another test the above process was repeated; but in this case the wheel was revolved during the whole 15 minutes, with the following results:

Blanket A, 0.24 per cent shrinkage.

Blanket B, 1.57 per cent shrinkage.

Evidently the continued motion of the wheel tended to increase the shrinkage.

Summarizing the experiments with the wash wheel it was shown that all lice and eggs can be killed in the laundry wash wheel alone by washing at a temperature of 131° F. for 15 minutes, and rinsing three times at the same temperature. When there is any fear of infecting the wash wheels from hospital linens, etc., the clothes can be soaked at 165° F. for 15 minutes, without motion, except to revolve the wheel two or three times every 5 minutes; or a current of live steam can be passed through the clothes for 15 minutes before the washing. It is not believed, however, that either of these processes is necessary if a hot tumbler is used at the end of the cleansing process.

EXTRACTION.

The laundry extractor has no significance whatever in the disinfecting processes. It merely serves to draw off all superfluous water before drying.

The Drying Process.

Drying is done in hot-air tumblers, which consist of large metal chambers with heated coils and inner revolving cages. The moist hot air is driven out of the tumbler by a fan. The temperature ordinarily obtained in a drying tumbler makes this step in the process effective in destroying both the active stages and the eggs of body lice.

That is to say, when clothes are dried therein for 15 minutes or more, at a temperature of 140° F. and higher, there is absolute assurance that all stages of the louse will be killed. It is important to insist on a minimum of 140° F. at the beginning of the drying process, the temperature being taken at the exhaust. The drying machine, therefore, plays an important part in the disinfecting process in the laundry. It was shown, however, that woolen goods must enter the tumbler in the wet state and must be removed while still somewhat moist in order to insure no shrinkage.

A number of experiments were conducted bearing on this point, and the results indicated that woolens could be partially dried in a tumbler without shrinkage to any great extent. The final drying would have to be done gradually, with the garment well stretched, as, for instance, in a flat-work ironer. This method of finishing was actually employed. The woolens were in the hot-air tumbler (187° F. at the point of discharge) for 15 minutes and then passed through the flat-work ironer, with the following results:

O. D. shirt, 2.98 per cent stretch.

Undershirt, part wool, army issue, 3.25 per cent stretch.

Sock, part wool, army issue, 12.50 per cent stretch.

Undershirt, fleece lined, 2.10 per cent stretch.

With the usual washing formulas, in which the clothes are washed at any temperature below 131° F., with the washing machine in motion, and then continuing through the rinses and the extractor, ending with the 15-minute tumbling in the dry tumbler, there was no shrinkage, but there was stretch. It is therefore obvious that the dry tumbler did not shrink the woolens, although it reached a temperature of 187° F. at the point of discharge.

It was likewise shown that even when the clothes were soaked at 165° F., without motion, then washed, extracted, and partially dried in the tumbler, there was no shrinkage.

An experiment was conducted by placing dry clothing in the tumbler and closing it up, but not revolving it; thus duplicating conditions of the hot-oven process of delousing. The temperature taken inside the tumbler at the beginning of the experiment was 145° F., and at the end of the run it was 150° F.; at the beginning the temperature reading at the exhaust was 143° F., and at the end, 149° F.

An O. D. wool shirt with specimens of lice-infested cloth in the pockets was exposed to those temperatures for 15 minutes. The following results were obtained:

Treated, 39 eggs, 1 to 3 days old, 1 hatched (2.5 per cent).

Check, 54 eggs, 1 to 3 days old, 44 hatched (81.5 per cent).

Treated, 54 eggs, 5 to 7 days old, none hatched (0 per cent).

Check, 100 eggs, 5 to 7 days old, 52 hatched (52 per cent).

This shirt was the only article in the tumbler at the time. Tests made of the shirt before and after heating showed an average shrinkage of 1.5 per cent.

It therefore appears that the 15-minute exposure to the dry air temperatures of this experiment was not completely effective, and furthermore it causes shrinkage of woolens.

SUMMARY OF EXPERIMENTS WITH DRYING TUMBLER.

It is concluded from these experiments with the drying tumbler that it is an effective and noninjurious part of the process of cleaning woolens and of disinfecting and of killing insects, when the clothing is treated wet, but that it is not desirable to use the drying tumbler as a preliminary measure in the disinfection and disinsection process, or as the only measure, because of the effect of dry heat on the shrinkage of woolens.

Finishing Processes.

Observations were made on the ironing processes at a commercial establishment where both hand gas irons and the steam press are used. Figures are given on the time consumed in the pressing of garments by each method. Similar observations in a cantonment laundry showed that the average time required to press one garment was 10 minutes. Piecework in the commercial establishment was somewhat more rapid.

Pieces of cloth with eggs attached were sewed along the seams of coats below the armhole or placed inside the pockets, and the garment was handed over to an operator who did not know what was in the coat nor the object of the test.

HAND PRESSING OF O. D. COATS.

Hand pressed, 33 eggs, 1 to 3 days old, 0 hatched (0 per cent).
Hand pressed, 68 eggs, 1 to 3 days old, 0 hatched (0 per cent).
Check, 54 eggs, 1 to 3 days old, 44 hatched (81.5 per cent).

STEAM PRESSING OF O. D. WOOL GARMENTS.

Coat, steam pressed, 51 eggs, 1 to 3 days old, 1 hatched (2 per cent).
Check, 54 eggs, 1 to 3 days old, 44 hatched (81.5 per cent).
Coat, steam pressed, 155 eggs, 0 to 2 days old, 0 hatched.
Trousers, steam pressed, 235 eggs, 0 to 2 days old, 0 hatched.
Check, 125 eggs, 0 to 2 days old, over 60 per cent hatched.

These experiments indicate that ordinary ironing and the work on the steam press are effective when the work is done carefully.

Complete Washing Formula.

Complete washing formulas were studied, with a view to determining their effectiveness on the eggs of lice. Two experiments were conducted in which shirts containing eggs and lice were placed in the wash wheel with the usual load of clothing and washed according to the following formula:

Fifteen minutes, heavy suds, water at 125° F.
Three 3-minute rinses, water at 125° F.
Extracted 20 minutes.
Tumbled, 15 minutes, 187° F. at point of discharge.

All eggs and lice were found to be dead. The experiments were repeated twice, at a temperature of 131° F. In these cases all stages of lice were destroyed.

Washing of Cotton Goods.

Since the above processes destroy lice and eggs in woolens, it is therefore safe to assume that it destroys lice in flat work, khaki, and cotton underwear. In these classes of work higher temperatures of the water and longer wash formulæ are employed than those mentioned above.

Recommendations.

In view of the foregoing tests there is proposed as a measure in disinsection of woolens a process which not only will disinsect, but also will cleanse the garment and return it to the owner in good form, without undue shrinkage. This process consists of the following measures:

1a. In the washer run a current of live steam for 15 minutes, revolving the cylinder every 5 minutes, and discharging water of condensation every 5 minutes. Remove the garments and shake until almost dry. This requires only a few shakes.

1b. Submerge in water at 165° F. for 20 minutes, without motion, except a few revolutions every 5 minutes.

2. Wash 15 minutes at 131° F. in heavy suds and light load.
3. Rinse three times, 3 minutes each, at 131° F.
4. Extract.
5. Run in tumbler for 15 minutes, at a minimum of 140° F.

Live steam (1a) or very hot soaking (1b) are advised only in cases where there is no heated tumbler (5) available, or where the garments are suspected of being contaminated with very resistant spore-bearing bacteria.

In other words, the usual laundry methods for the disinfection and disinsection are recommended because of their added value of cleansing.

There can be no doubt that the ordinary processes of the laundry will kill all lice and their eggs, and probably all insect life.

It is proved that woolens can be treated at a temperature which will kill lice and bacteria, without undue shrinkage—that is 131° F. Washing in heavy suds, with motion; 165° F. soaking, without motion; live steam, without motion, and occasionally removing the water of condensation; or dry tumbling of wet garments; these do not cause undue shrinkage of woolens.

DEATHS DURING WEEK ENDED MAR. 26, 1921.

Summary of information received by telegraph from industrial insurance companies for week ended Mar. 26, 1921, and corresponding week, 1920. (From the "Weekly Health Index," Mar. 29, 1921, issued by the Bureau of the Census, Department of Commerce.)

	Week ended Mar. 26, 1921.	Corresponding week, 1920.
Policies in force	46,386,036	42,645,355
Number of death claims	8,372	11,555
Death claims per 1,000 policies in force	9.4	14.1